Palynology of the southern Gunbarrel Basin *

C L MACK

Environmental Inorganic Geochemistry Group, Curtin University of Technology, Brodie Hall Building, 1 Turner Avenue, Technology Park, Bentley, WA 6102, Australia. ✉ *charlotte.mack@postgrad.curtin.edu.au*

The Narnoo Basin is a small intracratonic basin in the southwest region of the Gunbarrel Basin adjacent to the northeast margin of the Yilgarn Craton in Western Australia (Fewster 1999). The basin is currently being explored for uranium with gold and heavy base-metals having already been discovered. The current exploration program, commenced in 2007 by Energy and Minerals Australia (EMA), centres on the Mulga Rocks deposits. To date, four separate zones of uranium mineralisation have been delineated, all of which are associated with a paleochannel. At present only preliminary lithostratigraphic schemes are in use for sediments younger than Cretaceous age and these are constrained to localised areas around mineral deposits. Correlation using this informal system is proving inadequate as further drilling is completed. With no age constraint, the informal units proposed by EMA are difficult to correlate.The aim of this research program is to resolve issues associated with the lateral continuity of units, the age of the basement rock intersected during both recent and previous (1970s Petroleum and Nuclear Corporation Exploration Pty Ltd), drilling programs, and the significance of faulting across the Narnoo Basin.

The successful use of biostratigraphy, in particular palynology, in correlating similar sediments in the Gippsland Basin, southern Victoria (Stover & Partridge 1973), has led to the proposal that similar techniques be applied to the Narnoo Basin. The lack of appropriate lithology which can be used for radiometric dating and the lack of recognisable marine incursions in the Narnoo Basin indicate that palynology is the best method available for the correlation of these strata. Palynological analyses involve the identification and abundance of pollen and spore species present in the rock record. As the vegetation changes within an area, the pollen assemblages preserved record these temporal changes. In addition to potentially being able to date these sections, palynology will also facilitate a study of the paleovegetation, which involves the reconstruction of flora through geological history. This is particularly important as research has indicated that the species present in Western Australian Cenozoic sediments are remarkably different when compared to eastern Australian assemblages of similar age (Milne 1988). Little Cenozoic palynological work has been done in southwestern Australia to date as compared to eastern Australia, and there are no Western Australian biozones for this time.

Samples collected for palynological analysis (Mack 2011) were processed using hydrofluoric (HF) and hydrochloric (HCl) acid to remove the mineral content and nitric acid (HNO_3) and sodium hydroxide (NaOH) to oxidise extraneous organic material (Phipps & Playford 1984). So far, a total of 186 species of cryptogam spores and angiosperm and gymnosperm pollen have been recovered from 16 samples (Mack 2011). Of these 102 are new species that have not been described in previous Australian work, and are mainly *Tricolpites* spp, *Rhoipites* spp, *Tricolporites* spp and *Proteacidites* spp. The general characteristics of these assemblages are distinctly Eocene with several species conformable with the Middle *Nothofagidites asperus* Zone of the Gippsland Basin (Stover & Partridge 1973) and its equivalent in the Murray Basin, dated as late Eocene (Macphail 1999). A further 120 samples have been collected for this current study.

It is projected that correlation of the stratigraphic units established by EMA with units intersected by other companies operating in the area will assist further exploration and the discovery of new uranium deposits. Analysis of the palynomorph assemblages recovered will include: description of new species, delineation of biostratigraphic zones, palynostratigraphic correlation of units of the Narnoo and Gunbarrel Basins, and construction and comparison of pollen assemblage distribution charts for the Gunbarrel, Eucla and Bremer Basins. Thiswill provide the foundation for a high-resolution spore–pollen biostratigraphic framework for the Western Australian Cenozoic sediments. Biostratigraphy utilising palynology has proved highly successful for the correlation of sediments and is recognised as an essential tool in the petroleum, mineral and groundwater exploration industries.

In addition to biostratigraphic correlation, comparison of the pollen and spore assemblages recovered from Narnoo Basin core with assemblages from the western Eucla and Bremer Basins will provide a better understanding of southwestern Australian Cenozoic paleovegetation. Comparison of fossil species with modern pollen and spores will determine their likely botanical affinity and the implications of these relationships for paleoenvironment reconstruction. Relation of southwestern paleovegetation with studies completed in southeastern Australian Cenozoic basins will allow for investigation of the evolution and differentiation of flora across southern Australia during the Cenozoic, and its response to local and global environmental change that is important in today's changing environment.

* Extended abstract of a paper presented at the Royal Society of Western Australia Postgraduate Symposium 2012 held at Curtin University on 29 September 2012.

ACKNOWLEDGEMENTS

I would like to acknowledge: my Honours supervisor, and PhD co-supervisor, Lynne Milne for envisioning this project and her contributions to my understanding of palynology; the ongoing help and support of my supervisor Associate Professor Kate Trinajstic; and Energy and Minerals Australia for providing material for study including samples, cross-sections and maps of the study area, field work and funding the project.

REFERENCES

Fewster M 1999.The geology of the Narnoo Basin, Western Australia, and origin of the gold, base-metal, and uranium mineralisation during the Late Cenozoic. MSc thesis, University of Western Australia, Perth (unpubl.).

Mack C L 2011. Tertiary palynology of the southern Officer Basin, Western Australia. Honours thesis, Curtin University, Perth (unpubl.).

Macphail M K 1999. Palynostratigraphy of the Murray Basin, inland southeastern Australia. *Palynology* **23**, 197–240.

Milne L A 1988. Palynology of a late Eocene lignitic sequence from the western margin of the Eucla Basin, Western Australia. *In:* Jell P A & Playford G (eds.) *Palynological and palaeobotanical studies in honour of Basil E Balme*, pp. 285–310. Association of Australasian Palaeontologists Memoir 5.

Phipps D & Playford G 1984. Laboratory techniques for extraction of palynomorphs from sediments. *Papers of the Department of Geology, University of Queensland* **11(1)**, 1–23.

Stover L E & Partridge A D 1973. Tertiary and Late Cretaceous spores and pollen from the Gippsland Basin, southeastern Australia. *Proceedings of the Royal Society of Victoria* **85**, 237–286.